PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements relating to Closing Mechanism for an Electric Circuit Breaker

We, THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, a British Company having its registered office at Crown House, Aldwych, London, W.C.2, and MARCUS CHARLES INMAN HUNTER, of 12, Fairfield Avenue, Whitton, Twickenham, in the County of Middlesex, a British Subject, do hereby declare the nature of this invention to be as follows:—

In cases where the closing operation of an electric circuit breaker represents a comparatively heavy duty calling for mechanical aid, it is convenient to employ for such operation an actuating mechanism of the kind adapted to respond to the release of energy which has been stored in a spring, and it is to mechanism of this kind that the present invention relates.

Mechanism of the aforesaid character has been previously proposed in which the spring is adapted to be brought into a charged condition by means of a ratchet winder device capable also of having its restraint upon the spring removed at an instant when it is desired to allow the spring to have freedom to expand its energy and thereby cause the actuating mechanism to perform the closing movement of the breaker.

Now, the energy liberated upon sudden release of a loaded spring for mechanism of the nature already referred to is liable not only to act violently upon parts of the mechanism at the outset of the closing operation, but also to produce an undue acceleration of the movable contact member of the breaker. An object of the present invention, however, is to minimise these disadvantages.

According to the invention the actuating mechanism embodies flywheel means as an element of control for the movement produced by the action of the spring, said means preferably also constituting part of a ratchet winder device for the spring.

In one manner of carrying the invention into effect a flywheel suitably mounted for rotation carries a crank member arranged so that during one half revolution thereof into a dead centre position the spring is loaded progressively, the latter being then ready to drive said member and flywheel over the path that is available beyond the dead-centre. The movement of the flywheel which brings the crank into the dead centre position represents a winding-up operation on the spring and is arranged to take place in step-by-step manner through motor or hand operated ratchet means co-operating with a part of the flywheel. Preferably the flywheel is ratcheted into a position where the crank is brought just over its dead-centre position and is held there by means of a removable stop the release of which enables the spring to exert the further movement of the crank when the closing operation of the circuit breaker is intended to occur. This further movement is therefore also under the control of the flywheel.

In one construction of actuating mechanism according to the invention and as applied to a circuit breaker having trippable means of the reset type for ensuring the opening of the breaker the spring is of a compressible kind and arranged, when being allowed to expand, to cause a member movable therewith to drive against one end of a plunger whose other end is operatively connected to the movable contact member of the breaker. This plunger whilst having its one end mechanically connected to the contact member and associated trippable means, has its other end remaining uncoupled with any part of the spring closing mechanism in the sense that it offers only an abutment against which the member that moves during expansion of the spring can be caused to act for bringing about the closure of the breaker. Hence, if the breaker is already closed and the spring is in a compressed condition the abutment end of the plunger will be held clear of said member that moves with the spring. Preferably, the plunger is arranged vertically, and upon an upward travel thereof it operates on a bell crank connected to the movable contact member of the breaker, whilst a downward travel of this plunger is effected by gravity or a light spring and resets the trip free mech-

anism after the breaker has been tripped out.

Conveniently, the compressible spring is situated vertically within a framework structure at the head of which is located the plunger and the mechanism through which an upward movement of the plunger results in closure of the breaker. At a lower portion of this structure two similar flywheels joined together by a suitably disposed crank pin are each journalled so as to rotate on a common horizontal axis, the crank pin being coupled through a connecting rod to one end of a vertically movable double sided lever whose other end is pivoted to a fixed fulcrum. The lever is thus able to perform vertically a complete reciprocation in response to a complete revolution of the jointly rotatable flywheels. By means of suitable link connections a vertically movable cross-head member is arranged to follow this reciprocating movement of the lever, the cross-head being adapted continually to bear against the upper end of the compressible spring and to load the latter when moving downwards. Integrally attached to the cross-head is a vertically depending tube extending freely within the space bounded by the coils of the vertical spring, said tube having an open upper end for reception of the lower part of the main vertical plunger connected to the contact member of the breaker, whilst the lower end of the tube is closed and supports by way of a pre-loaded damping spring an actuating plunger member against which the main plunger abuts when the breaker is open. On an upward travel of the cross-head and therewith the tube, the damping spring and actuating plunger member, the main plunger will be forced upwards, assuming that the breaker is not already in the closed position.

Over a part of the periphery of one of the flywheels is provided a series of ratchet teeth or notches with which a suitably arranged set of ratchet pawls can be made to co-operate so as under motor or hand operation to rotate the flywheel set in stages and bring the spring into its compressed condition. These teeth or notches are arranged over the periphery so as to allow the flywheel to be ratcheted to an extent corresponding to just more than the half revolution which is needed to bring the crank pin to the bottom of its stroke with the spring being fully loaded. In order to prevent the crank pin from prematurely performing its upward stroke following this degree of ratcheting, the other flywheel has a notch in the rim thereof located so as to be engaged by a releasable roller prop when the crank pin has been brought into the position just over dead-centre. Moreover by arranging the ratchet teeth so as not to cover more than the range of movement just referred to it will be seen that once the roller prop engages with the aforesaid notch, then further ratcheting of the other flywheel either by hand or by motor operation is ineffective since the rim of that flywheel presents no further teeth on which a pawl could act and the latter would simply ride freely on a plain part of that rim. In the case of motor operation, therefore, where a continuously rotating eccentric might be used to effect reciprocation of a ratcheting pawl no other declutching device would be required. In the case of hand operation a manually operable lever may be mounted with freedom to rock on the axles of the two flywheels and carrying at one end a suitable ratchet pawl it being understood that in either of the foregoing cases a suitable holding ratchet means will be provided to engage with the ratchet teeth and permit the flywheels to revolve only in one direction.

The downward stroke of the crank pin and connecting rod which occurs during the ratcheting operation causes the cross-head to compress the spring and thereby store sufficient energy to close the circuit breaker. Upon withdrawal of the roller prop which may have a switch associated therewith for giving an indication as to whether the spring is in a loaded or unloaded condition, the ensuing upward movement of the cross-head and the parts carried thereby is accompanied by partial revolution of the two flywheels and thus there is an absorption of energy by these flywheels at the instant of release of the spring, thereby reducing any tendency to shock on the light tripping parts and violent acceleration of the breaker cross-bar.

The kinetic energy given to the flywheels is restored at a later part of the stroke when the load from the spring is diminishing and when the breaker parts are tending to slow up due to short circuit forces, or heavy contacts.

Should the spring be released when the breaker is closed substantially the whole of the energy is converted to kinetic energy in the flywheels and subsequently given back to the spring, so that no dash pots of any kind are required. The energy returned to the spring usefully relieves the amount of work required to fully reload for the next operation.

Finally it will be appreciated that if there is more energy in the spring than is required to close the breaker, the excess is usefully returned to the flywheels with-

out destructive effect on the breaker mechanism.

Dated this 11th day of December, 1939.

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COMPLETE SPECIFICATION

Improvements relating to Closing Mechanism for an Electric Circuit Breaker

We, THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, a British Company having its registered office at Crown House, Aldwych, London, W.C.2, and MARCUS CHARLES INMAN HUNTER, of 12, Fairfield Avenue, Whitton, Twickenham, in the County of Middlesex, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In cases where the closing operation of an electric circuit breaker represents a comparatively heavy duty calling for mechanical aid, it is convenient to employ for such operation an actuating mechanism of the kind adapted to respond to the release of energy which has been stored in a spring, and it is to mechanism of this kind that the present invention relates.

Mechanism of the aforesaid character has been previously proposed in which the spring is adapted to be brought into a charged condition by means of a ratchet winder device capable also of having its restraint upon the spring removed at an instant when it is desired to allow the spring to have freedom to expand its energy and thereby cause the actuating mechanism to perform the closing movement of the breaker.

According to a further prior proposal, in connection with mechanism whereby a circuit breaker of the so-called free release type is closed upon the release of a preliminary compressed spring, it has been suggested to effect the compression of the spring by means of a hand or motor operated non-self-locking helical worm and worm wheel gearing permanently connected to the spring by way of a crank carried by the worm wheel. By rotation of the crank into a dead-centre position the spring is brought into its compressed condition, and the closing operation of the circuit breaker is effected by a continued rotation of the crank actuated by the spring alone, the said gearing permitting of and taking part in such further movement of the crank with a view also to exerting a damping action for mitigating shock upon parts of the circuit breaker. With this arrangement it has also been proposed to cause, when the crank reaches just beyond the said dead-centre position, the reaction between the wheel and worm of the said gearing to move the worm axially so that the latter becomes uncoupled from its hand or motor driving means and is then held temporarily locked or is connected to a disc or the like influenced by a brake.

Now, the present invention has to do with spring closing mechanism of the general character indicated, and a particularly simple and efficient way of ensuring that the energy liberated upon sudden release of the loaded spring shall neither act violently upon parts of the mechanism at the outset of the closing operation, nor also produce an undue acceleration of the movable contact member of the breaker resides in that in accordance with the invention means including a flywheel in operative connection with the spring are so incorporated with the mechanism that the energy releasing movement of the spring is controlled by flywheel action of the flywheel.

Preferably, the flywheel also constitutes part of a ratchet winder device for the spring, and to this end the flywheel may embody unitarily therewith the ratchet wheel component of co-operating hand or motor actuated pawl and ratchet wheel means for causing the flywheel to impart in step-by-step manner the movement for charging the spring.

Conveniently, the flywheel carries a crank member and is arranged so that during one half revolution thereof into a dead-centre position in response to the ratcheting operation the spring is loaded progressively, said spring being then ready to drive said member and flywheel over a path extending into the same direction beyond that dead-centre position. Preferably the flywheel is ratcheted into a position where the crank is brought just over its dead-centre position and is held there by means of a removable stop the release of which enables the spring to exert the further movement of the crank when the closing operation of the circuit breaker is intended to occur, which further movement is therefore also under the control of the flywheel.

According to a further feature of the

invention the flywheel may have the ratchet wheel component provided with its pawl-engaging notches (or their equivalent) extending only over a range limited to that required to bring (by ratcheting operation of the flywheel) the spring into the desired preliminary charged condition.

In one construction of actuating mechanism embodying the invention and as applied to a circuit breaker having trippable means of the reset type for ensuring the opening of the breaker, the spring is of a compressible kind and arranged, when being allowed to expand, to cause a member movable therewith to drive against one end of a plunger whose other end is operatively connected to the movable contact member of the breaker. This plunger, whilst having its one end mechanically connected to the contact member and associated trippable means, has its other end remaining uncoupled with any part of the spring closing mechanism in the sense that it offers only an abutment against which the member that moves during expansion of the spring can be caused to act for bringing about the closure of the breaker. Hence, if the breaker is already closed and the spring is in a compressed condition, the abutment end of the plunger will be held clear of said member that moves with the spring. Preferably, the plunger is arranged vertically, and upon an upward travel thereof it operates on a bell crank connected to the movable contact member of the breaker, whilst a downward travel of this plunger is effected by gravity or a light spring and resets the trip free mechanism after the breaker has been tripped out and during the spring-charging operation.

The invention will be more readily understood by reference to the accompanying drawings, wherein Figs. 1 and 2 are part-sectional side and front elevational views respectively of one form of circuit breaker closing mechanism embodying the invention, whilst Figs. 3 and 4 are similar views of a modified construction of closing mechanism suitable for a circuit breaker of smaller size.

Referring initially to Figs. 1 and 2, the numeral 1 designates a vertically arranged framework structure at the head of which is located the depending portion of a plunger 2 whose other end (not shown) is to be regarded as operatively connected to the movable contact member of a circuit breaker having trippable means of the reset type and so that closure of the breaker can take place in response to an upward movement of the plunger 2 from the position illustrated.

At a lower portion of the framework structure 1, two similar flywheels 3*a*, 3*b* joined together by a crank pin 4 are each journalled at opposite sides of the structure 1 so as to rotate on a common horizontal axis, the mounting of each flywheel being by way of a stub axle as at 5 (Fig. 2) supported by the structure and an intermediate ball bearing 6. The crank pin 4 is coupled through a connecting rod 7 to one end of a vertically movable double sided lever 8 whose other end is pivoted to a fixed fulcrum 9. The lever 8 is thus able to perform vertically a complete reciprocation in response to a complete revolution of the jointly rotatable flywheels 3*a*, 3*b*. By means of the link connections 10 at opposite sides of the lever 8, a vertically movable cross-head member 11 is arranged to follow this reciprocating movement of the lever 8, the cross-head 11 being adapted continually to bear by means of its portion 12 against the upper end of a compressible spring 13, the lower end of which rests upon a fixed support 14, whereby the spring 13 becomes loaded as the cross-head 11 is moved downwards. Integrally attached to the cross-head 11 is a vertically depending tube 15 extending freely within the space bounded by the coils of the vertical spring 13, said tube having an open upper end 16 for reception of the lower part of the main vertical plunger 2 connected to the contact member of the breaker, whilst the lower end of the tube is closed at 17 and supports by way of a pre-loaded damping spring 18 an actuating plunger member 19 against which the main plunger 2 abuts when the breaker is open and the spring 13 in charged condition. On an upward travel of the cross-head 11 and therewith the tube 15, the damping spring 18 and actuating plunger member 19, the main plunger 2 will be forced upwards, assuming that the breaker is not already in the closed position.

Over a part of the periphery of the flywheel 3*a* is provided a series of ratchet teeth 20 with which a suitably arranged set of ratchet pawls can be made to cooperate so as under motor or hand operation to rotate the flywheel set 3*a*, 3*b* in stages and bring the spring 13 into its compressed condition. These teeth 20 are arranged over the periphery so as to allow the flywheel 3*a* to be ratcheted to an extent corresponding to just more than the half revolution which is needed to bring the crank pin 4 to the bottom of its stroke with the spring 13 being fully loaded. In order to prevent the crank pin 4 from prematurely performing its upward stroke following this degree of ratcheting,

the other flywheel 3*b* has a notch 21 in the rim thereof located so as to be engaged by a releasable roller prop 22 when the crank pin 4 has been brought into the position just over dead-centre with the spring 13 in compressed condition. Moreover, by arranging the ratchet teeth 20 so as not to cover more than the range of movement just referred to, it will be seen that once the roller prop 22 engages with the aforesaid notch 21, then further ratcheting of the other flywheel 3*a* either by hand or by motor operation is ineffective, since the rim portion 23 of the flywheel presents no further teeth on which a pawl could act and the latter would simply ride freely on a plain part 23 of that rim.

For the purpose of ratcheting the flywheel set 3*a*, 3*b* by hand, a two-armed lever 24 is mounted with freedom to rock on the stub axles 5 and carries near one of its ends a ratchet pawl 25 pivotally connected thereto at 26 and biased against the periphery of the flywheel 3*a* by means of a spring and tail piece assembly 27. By inserting a tommy bar 28 into a recess 29 within the tie member 30 at the other end of the lever 24, and by acting manually upon the bar 28 so as to rock the lever 24, it will be seen that on alternate strokes of the pawl 25, the latter will work upon the ratchet teeth 20 and advance the flywheels 3*a*, 3*b* in a clockwise direction as shown by the arrow in Fig. 1. In order to permit the flywheels to revolve in only the one direction, a further pawl member 31 is spring mounted as at 32 (Fig. 2) so as to engage with the ratchet teeth 20 and prevent backward movement of the flywheel 3*a*.

The alternative use of a motor for driving the ratchet mechanism of the flywheel set 3*a*, 3*b* has also been indicated in Fig. 2, in which case a side of the framework 1 has a motor 33 fitted thereon and arranged in any suitable manner to drive an eccentric 34 co-operating with a rod and clevis 35 the reciprocation of which can be caused to impart the requisite reciprocating movement to the pawl 25 by an interconnecting lever system (not shown). With this latter mode of driving the ratchet mechanism, the provision of the smooth peripheral portion 23 of the rim of the flywheel 3*a* offers the advantage that even if the eccentric 34 should continue to rotate after the notch 21 has been engaged by the prop 22, further movements of the pawl 25 would be ineffective and no other declutching device would be required.

The downward stroke of the crank pin 4 and connecting rod 7 which occurs during the aforesaid ratcheting operation causes the cross-head 11 to compress the spring 13 and thereby store sufficient energy to close the circuit breaker. The roller prop 22, which also has a switch 36 associated therewith for giving an indication as to whether the spring 13 is in a loaded or unloaded condition, is arranged to be withdrawn from engagement with the notch 21 either by means of a manually operable push rod 37 or by an electrically operated trip plunger 38, whereupon the ensuing upward movement of the cross-head 11 and the parts 15, 19 carried thereby is accompanied by partial revolution of the two flywheels 3*a*, 3*b*, and thus there is an absorption of energy by these flywheels at the instant of release of the spring 13, thereby reducing any tendency to shock on the light tripping parts and violent acceleration of the breaker cross-bar.

In the modification shown in Figs. 3 and 4, the mechanism is arranged for effecting closure of a circuit breaker in response to a downward movement produced by the main chargeable spring, and in these Figures the various parts equivalent or corresponding to elements shown in Figs. 1 and 2 have been given the same reference numerals.

Thus, the flywheels 3*a*, 3*b* carry the crank-pin 4 arranged through connecting rod 7 and double sided lever 8 to effect a vertical reciprocation about the fixed fulcrum 9. The cross-head 11, however, is in this arrangement adapted to bear against the lower end of the main spring 13 whose upper end engages a fixed abutment 14. With the crank pin 4 in the lower position shown, the spring 13 is in its unloaded condition and it will be seen that by operating the ratchet pawl 25 so as to turn the flywheels 3*a*, 3*b* clockwise into just over the upper dead-centre position, the lever 8 will raise the cross-head and tube 15 to the extent indicated at 15*a* (Fig. 3). This represents the position wherein the spring 13 is maintained charged in readiness to lower the cross-head 11 and therewith cause a rod 2 to be drawn downwards. This rod 2, which passes freely through the closed end 17 of the tube 15 and has its narrowed lower end connected to the tube 15 by way of a fixing nut assembly 40 and member 41 bearing against the damping spring 18, constitutes the equivalent of the operating plunger 2 shown in Figs. 1 and 2 and is guided near its upper end through a guide bush 42 above which it has operative connection with suitable trip free mechanism and the movable member of the circuit breaker (not shown). Whereas in the arrangement according to Figs. 1 and 2, the plunger 2 is able to effect a reset-

ting of the trip free mechanism by falling under gravity influence (with or without the assistance of a light spring) the equivalent rod 2 shown in Figs. 3 and 4 requires to be lifted positively to perform the same operation. To this end the rod 2 carries a transversely arranged pin 43 extending at its ends through opposed longitudinal slots 44 within the guide 42 and bearing against the upper end of a spring 45 surrounding a part of the rod 2 and seated at its lower end upon the closed end 17 of the cross-head tube 15. The spring 45 thus constitutes a retrieving spring which takes the weight of the rod 2 and tends always to raise the rod for resetting the trip free mechanism. As will be seen from Fig. 3, the retrieving spring 45 is in its maximum state of compression when the cross-head occupies the upper position shown dotted at 15*a* and with the pin 43 located at the lower end of the slots 44. The requisite upward movement of the rod 2 for resetting the trip free mechanism is effected by expansion of the spring 45 so as to urge the pin 43 and therewith the rod upwardly to the extent shown at 43*a* (Fig. 3), the lower end of the spring 45 continually bearing upon the closed end 17 of the crosshead tube 15.

In both the arrangements illustrated the kinetic energy given to the flywheels 3*a*, 3*b* during the initial circuit breaker closing operation is restored at a later part of the stroke when the load from the main spring 13 is diminishing and when the breaker parts are tending to slow up due to short circuit forces, or heavy contacts. Moreover, upon release of the spring when the breaker is already closed, substantially the whole of the energy is converted to kinetic energy in the flywheels and subsequently given back to the spring, so that no dash pots of any kind are required. The energy returned to the spring usefully relieves the amount of work required to fully reload for the next operation.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. Mechanism for effecting the closure of a circuit breaker automatically in response to the release of energy which has been stored in a spring, wherein means including a flywheel in operative connection with the spring are so incorporated with the mechanism that the energy releasing movement of the spring is controlled by flywheel action of the flywheel.

2. Mechanism as claimed in Claim 1, and having the spring arranged to be brought into the charged condition by means of a ratchet winder device, wherein as part of the ratchet winder device the flywheel also serves to impart the movement for charging the spring.

3. Mechanism as claimed in Claim 1 or Claim 2, wherein the flywheel carries a crank member and is arranged so that during one half revolution thereof into a dead-centre position the spring is loaded progressively, said spring being then ready to drive said member and flywheel over a path extending in the same direction beyond that dead-centre position.

4. Mechanism as claimed in Claim 2 and Claim 3, wherein the winding-up operation on the spring occasioned by movement of the flywheel whereby the crank is brought into the dead-centre position is arranged to take place in step-by-step manner through hand or motor operated ratchet means co-operating with a part of the flywheel.

5. Mechanism as claimed in Claim 3 or Claim 4, having the flywheel arranged to be ratcheted into a position where the crank is brought just over the dead-centre position, and releasable means for holding said flywheel and crank in that position.

6. Mechanism as claimed in Claim 1 and any one of Claims 2 to 5, wherein the flywheel is combined with a further flywheel so as to form a pair of jointly rotatable flywheels interconnected by a crank pin, said crank pin having operative connection with a reciprocatable cross-head member continually bearing against one end of the chargeable spring.

7. Mechanism as claimed in Claim 6, wherein the first-mentioned one of the jointly rotatable flywheels has ratchet teeth or notches provided over substantially only half of its periphery for permitting a pawl actuating means to effect ratcheting of the flywheels jointly and therewith cause the cross-head to bring the spring into the loaded condition.

8. Mechanism as claimed in Claim 7, wherein the other flywheel has a notch or its equivalent at the periphery thereof disposed so as to be engaged by a releasable stop member when both the flywheels have brought the crank pin into just over the dead-centre position, whereby the spring is maintained temporarily loaded.

9. Mechanism as claimed in any one of the preceding Claims, wherein the spring is arranged so as when releasing its stored energy to cause a member movable therewith to drive against one end of a plunger whose other end is operatively connected to the movable contact of the circuit breaker and associated trippable means.

10. Mechanism as claimed in Claim 9,

wherein with the circuit breaker closed and the spring in the loaded condition the end of the plunger against which the movable member is adapted to drive is held clear of said member.

11. Mechanism as claimed in Claim 9 and Claim 10, wherein the plunger is arranged vertically with its upper end operatively connected to the movable contact member, the downward travel of said plunger being effected by gravity or a light spring so as to reset a trip free mechanism after the circuit breaker has been tripped out.

12. Mechanism as claimed in any one of Claims 6 to 11, having the spring arranged vertically with its lower end fixed and the cross-head member continually bearing against the upper end of the spring.

13. Mechanism as claimed in Claim 12, wherein the cross-head member carries a vertically depending tube extending freely within the space bounded by the coils of the vertical spring, the lower end of the tube being closed and supporting by way of a pre-loaded damping spring an actuating plunger member against which the plunger as claimed in Claim 11 abuts when the circuit breaker is open.

14. Mechanism as claimed in Claim 9, modified in that with the spring arranged vertically with its upper end fixed and the cross-head member continually bearing against the lower end of the spring the plunger is replaced by an operating rod extending vertically downward within the space bounded by the coils of the spring and having connection with the cross-head member whereby the release of the spring causes the operating rod to be pulled downwards to effect the closure of the circuit breaker.

15. Mechanism as claimed in Claim 14, wherein the connection between the operating rod and the cross-head includes a damping spring.

16. Mechanism as claimed in Claim 14 or Claim 15, wherein the connection between the operating rod and the cross-head co-operates with a retrieving spring arranged so as to take the weight of the rod and effect an upward movement thereof requisite for resetting trip free mechanism for the circuit breaker after the latter has been tripped out.

17. Spring closing mechanism for an electric circuit breaker, constructed substantially as herein described with reference to Figs. 1 and 2, or Figs. 3 and 4, of the accompanying drawings.

Dated this 10th day of December, 1940.

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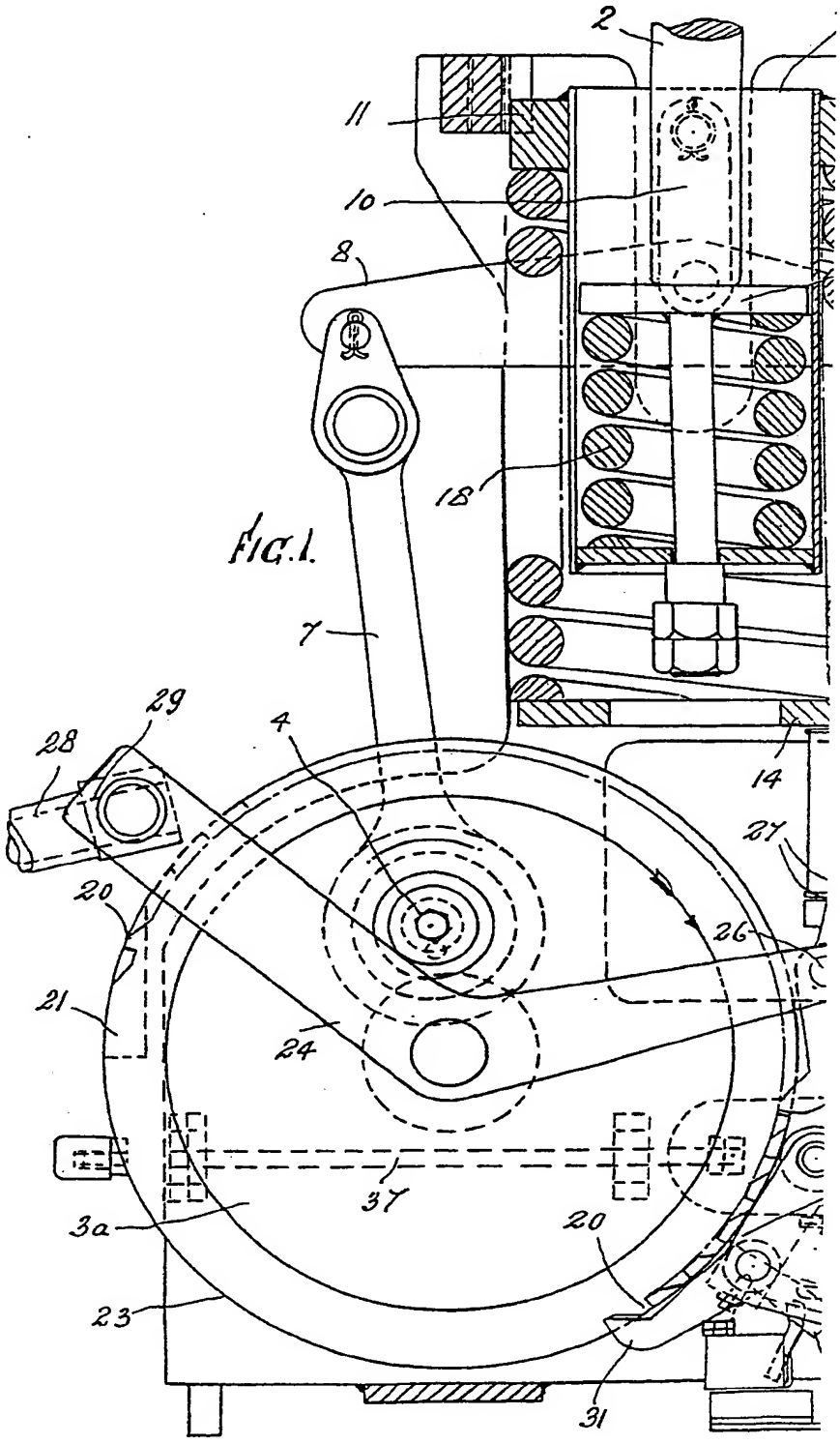

FIG. 1.

4 SHEETS

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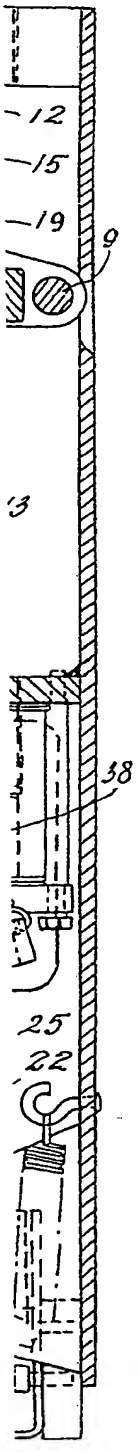

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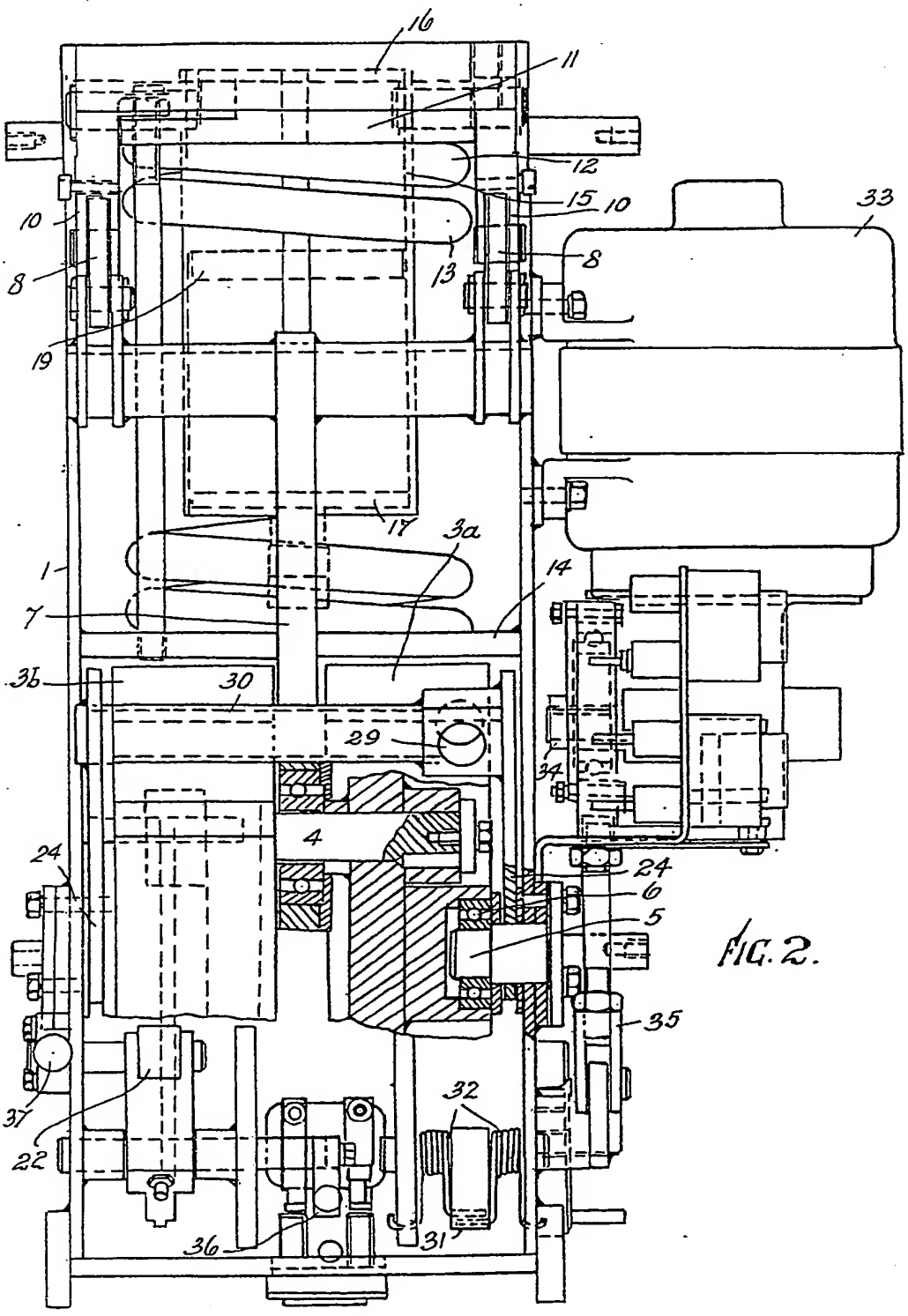

FIG. 2.

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4 SHEETS

SHEET 1

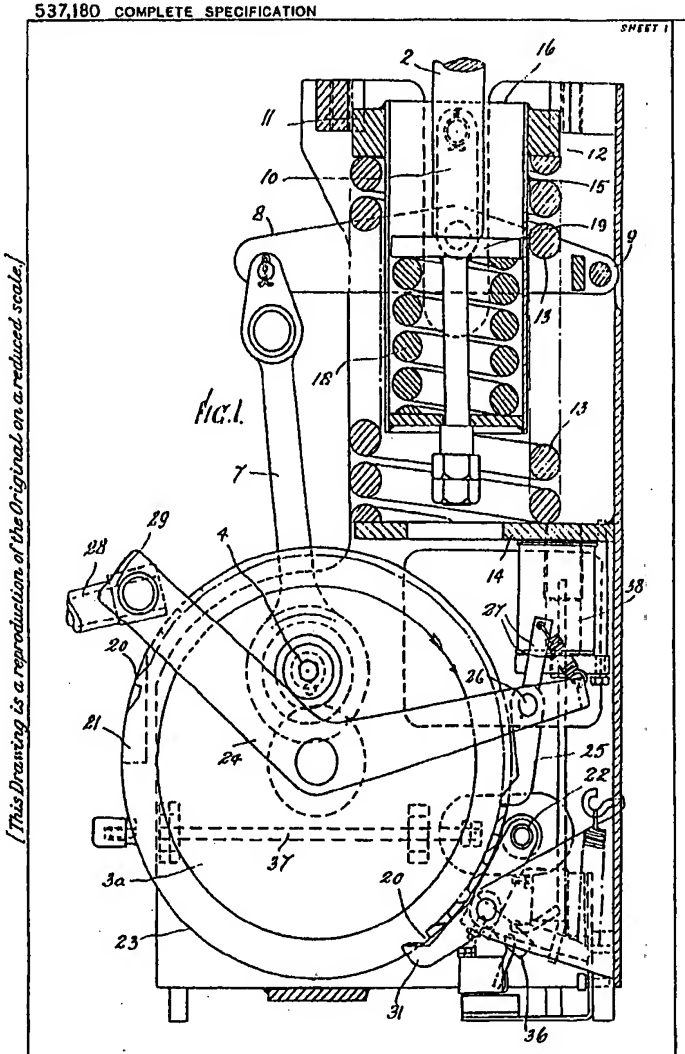

FIG. 1.

SHEET 2

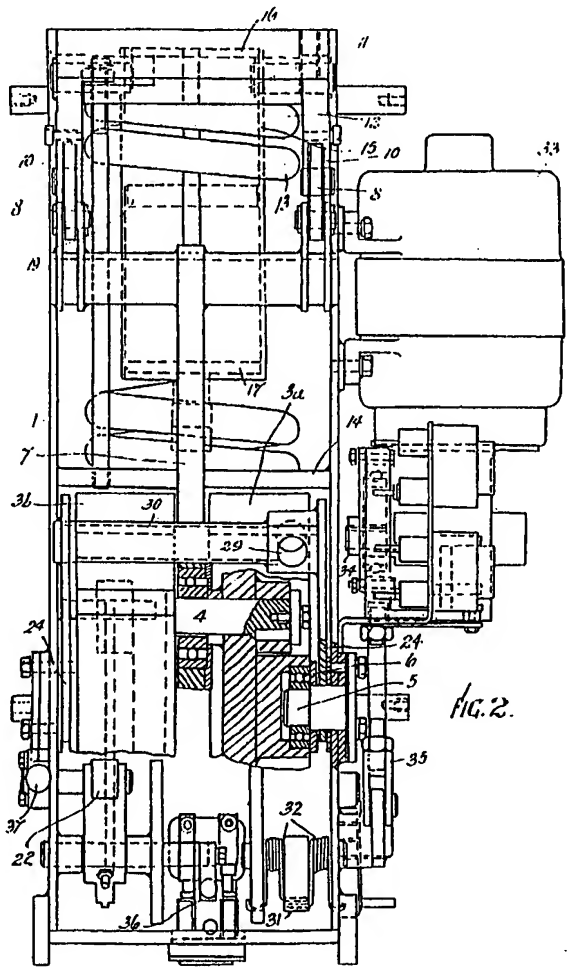

FIG. 2.

[This Drawing is a reproduction of the Original on a reduced scale.]

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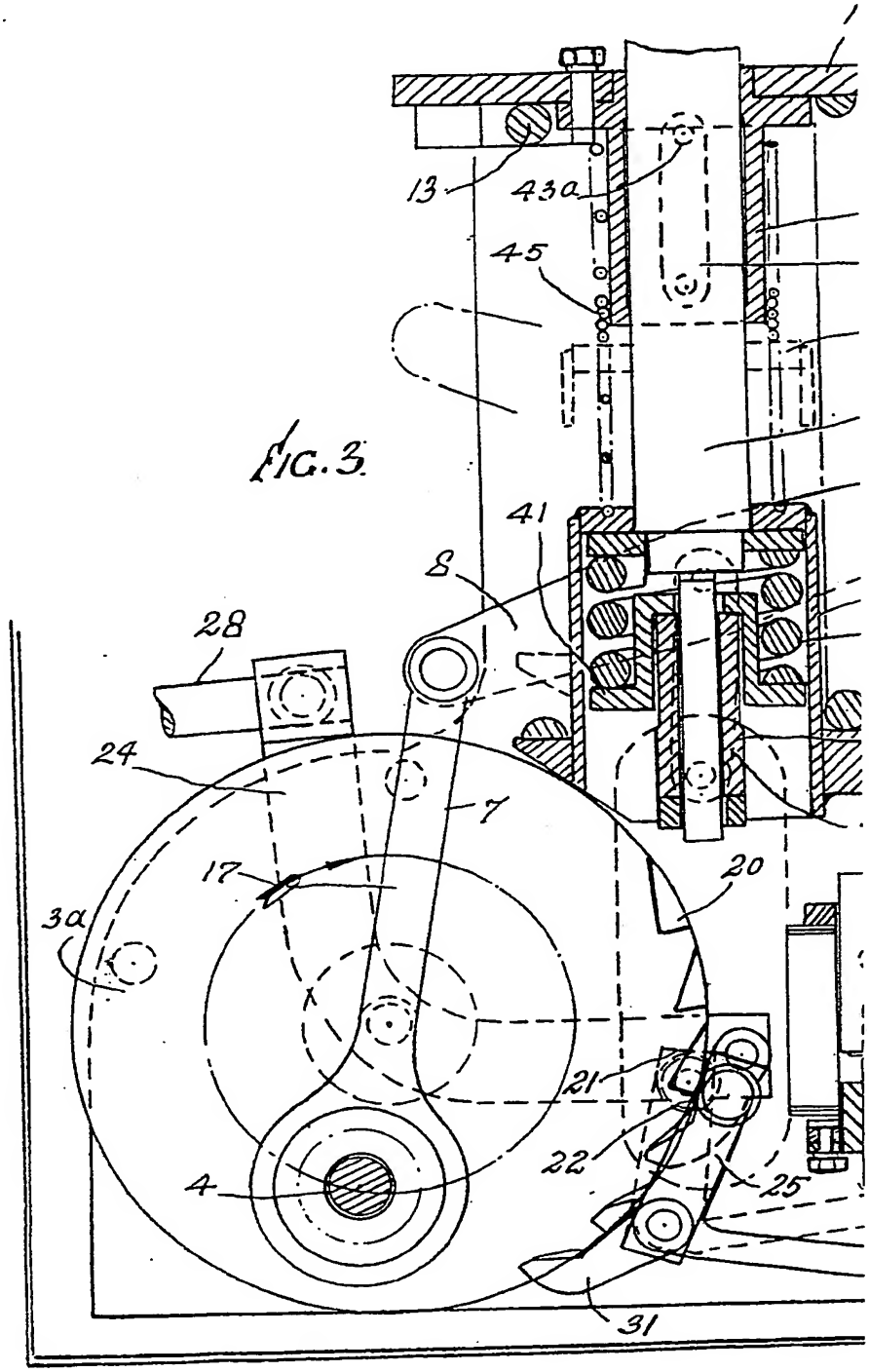
[This Drawing is a reproduction of the Original on a reduced scale.]

FIG. 3.



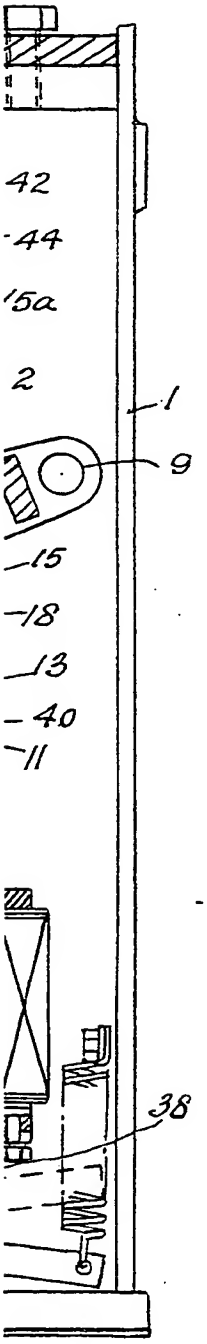
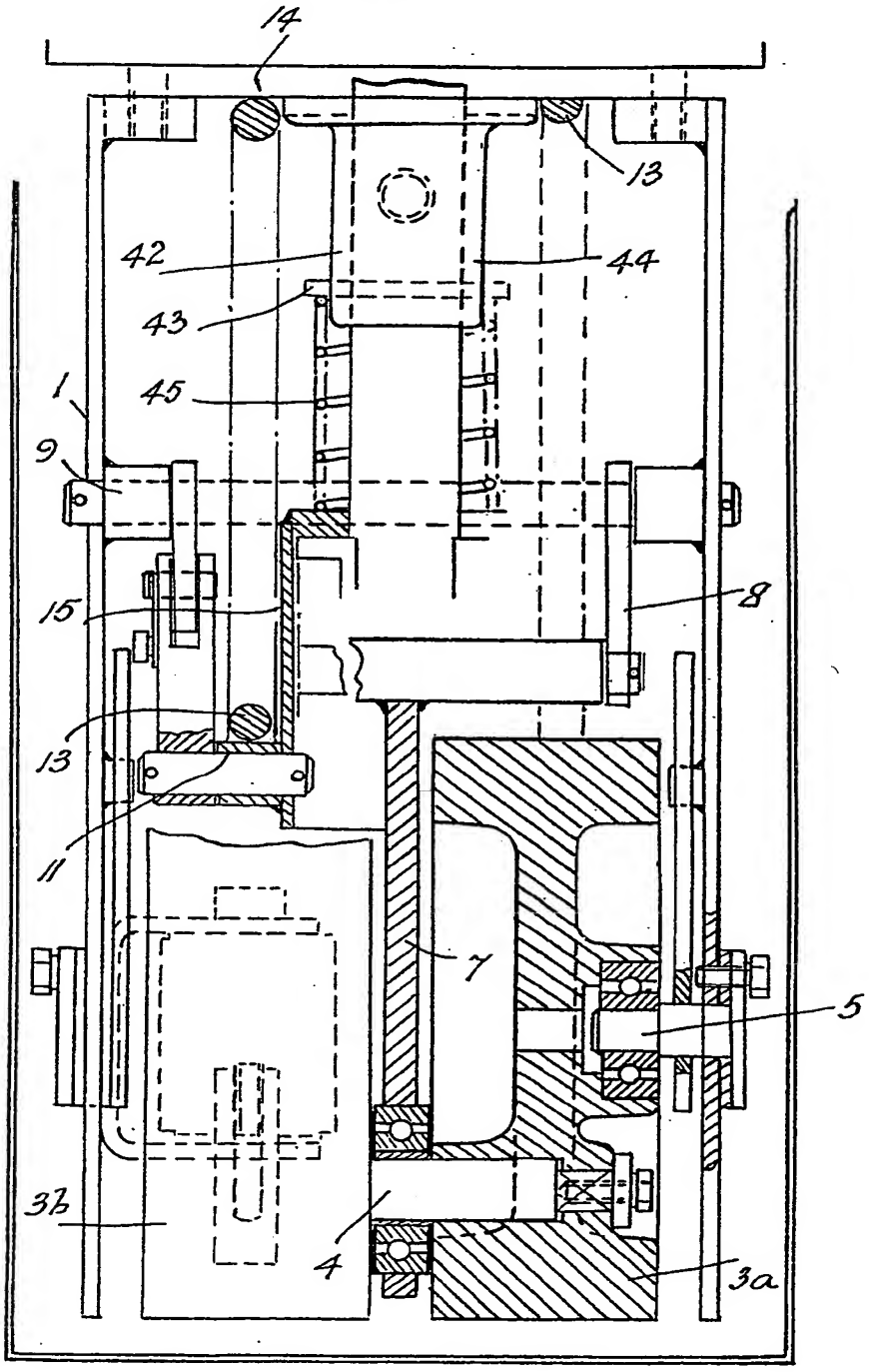


FIG. 4



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4 SHEETS

SHEET 3

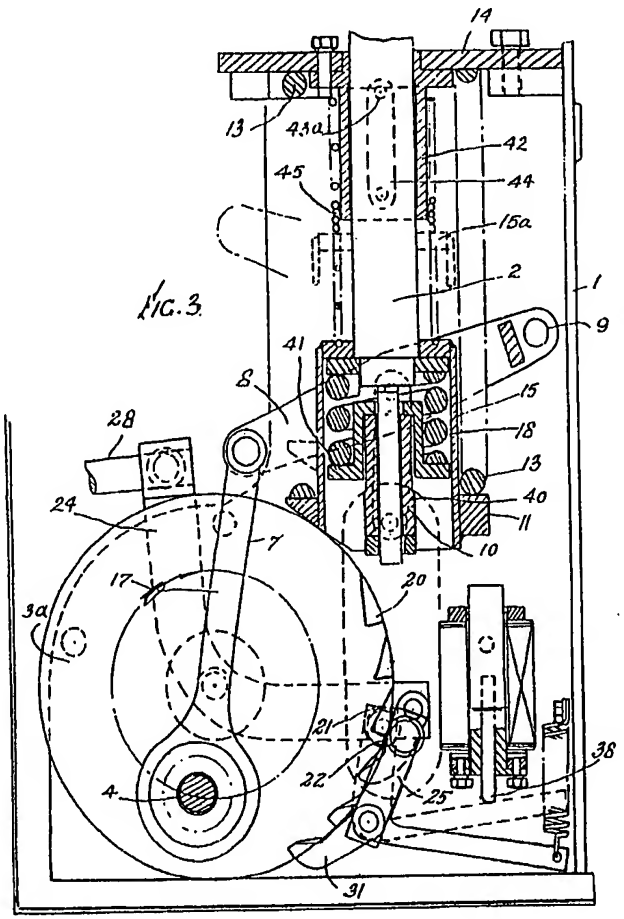

FIG. 3.

SHEET 4

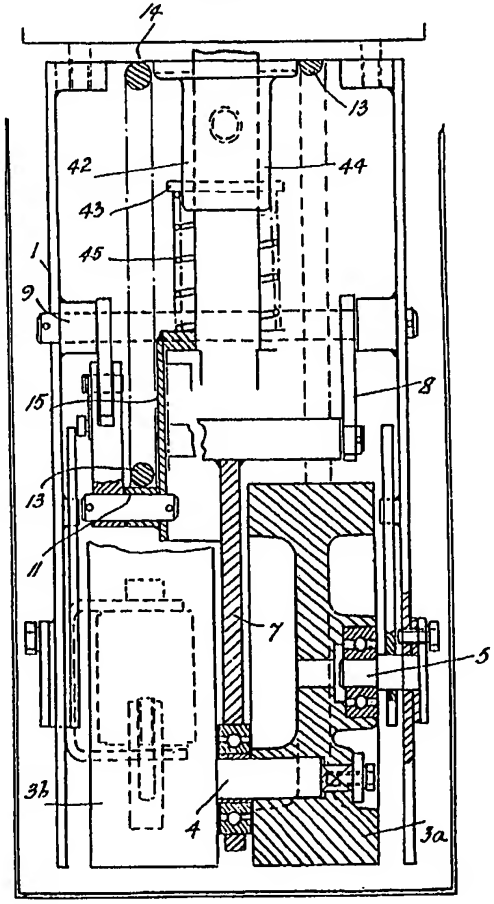

FIG. 4.

[This Drawing is a reproduction of the Original on a reduced scale.]

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